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Consequence Analysis with MACCS2

Session on Severe Accident Code Analysis and Fukushima Response Activities

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U.S.NRC **Outline**

- Overview
- MELCOR Accident Consequence Code System V.2 (MACCS2) Modules
- MELCOR Accident Consequence Code System V.2 (MACCS2) Pre-processor Codes
- WinMACCS Architecture and Graphical User Interface
- MELCOR Accident Consequence Code System V.2 (MACCS2) Uses

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U.S.NRC **Overview: Background**

- Tool used to assess the risk and consequence associated with a hypothetical release of radioactive material to the atmosphere.

- Evolved from codes used in the 1970's and the 1980's.

- Accounts for:
  - Transport and dispersion in the atmosphere and deposition to ground
  - Exposure due to inhalation, ingestion, and external irradiation
  - Protective actions during emergency and long-term phases

- Estimates consequence in terms of:
  - Health effects
  - Economic impacts

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U.S.NRC Overview: Pathways

MACCS2 models the radioactive release to the atmosphere (e.g. plume rise, dispersion, dry and wet deposition)
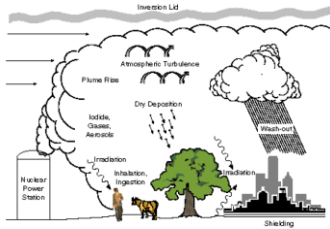
MACCS2 estimates the health effects from: inhalation, cloud shine, ground shine, skin deposition, and ingestion (e.g. water, milk, meat, crops)

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U.S.NRC MACCS2 Modules

- ATMOS
  – Atmospheric transport and dispersion

- EARLY (1 day to 1 week)
  – Emergency-phase countermeasures and consequences
  – Consequence altered by sheltering, evacuation, and relocation (i.e. Protective Action Guides (PAG))

- CHRONC
  – Intermediate (0 to 1 year)
  – Long-term consequences (0 to 317 years; 50 years typical use)
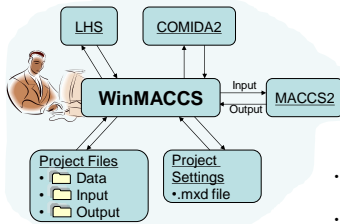 – Consequence altered by decontamination, interdiction, and condemnation (i.e. Protective Action Guides)

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U.S.NRC MACCS2 Preprocessors

- SECPOP2000 code
  – US site specific population distribution (based on 2000 census data)

- MELMACCS code
  – Utility for creating a MACCS2 formatted source term from MELCOR

- Dose Conversion Factor utility codes and files
  – DOSFAC2 code
  – FGRDCF code
  – ICRP-68/72 file

- COMIDA2 code
  – Food chain
  – Includes decay and ingrowths
  – A standard file is distributed with MACCS2/WinMACCS

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Architecture of WinMACCS

- WinMACCS(Graphical user interface)
  - Organizes all data needed to run MACCS2
  - Constructs input files
  - Enables sampling and processing of uncertain inputs
  - Post-processes results

Latin Hypercube Sampling (LHS): Performs stratified random sampling of input variables

- COMIDA2: Creates food-chain inputs to MACCS2

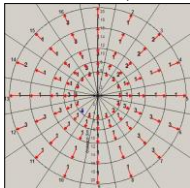- MACCS2: Analyzes consequences from atmospheric release of radionuclides

Note: WinMACCS has tools for post processing of MACCS2 output (e.g. plots of complementary cumulative distribution function (CCDF))
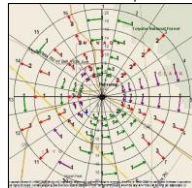
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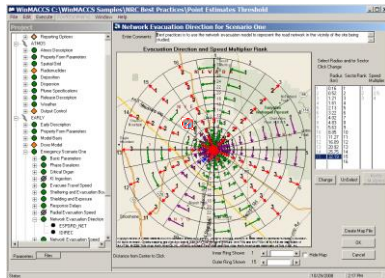
WinMACCS GUI

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WinMACCS: Network Model Input

Radial Evacuation Specification

Network Evacuation Specification

Enables graphical user modeling input implementation of road networks for population movements in multiple directions

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U.S.NRC MACCS2 Uses

- Probabilistic Risk Assessments (e.g., NUREG-1150)

- Severe accident studies (e.g., State-of-the-Art Reactor Consequence Assessment (SOARCA))

- National Environmental Policy Act Studies;
  - License renewal
  - New reactor applications

- Other Federal agencies and international organizations

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Backup Slides

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U.S.NRC List of Acronyms

- CRAC: Calculation of Reactor Accident Consequences
- DBA: Design Basis Accident
- DCF: Dose Conversion Factor (used to calculate doses from exposures)
- DOE: Department of Energy
- EIS: Environmental Impact Statement
- EPA: Environmental Protection Agency
- GUI: Graphical user interface
- LHS: Latin Hypercube Sampling
- MACCS: MELCOR Accident Consequence Code System
- MACCS2:   MELCOR Accident Consequence Code System (version 2)
- NEPA: National Environmental Policy Act
- NRC: Nuclear Regulatory Commission
- PAG: Protective Action Guides for EPA
- PRA: Probabilistic Risk Assessment
- SAMA: Severe Accident Mitigation Alternatives
- SAR: Safety Analysis Report
- SOARCA: State-of-the-Art Reactor Consequence Assessment

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U.S.NRC **References**

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